REMARKS

First, we point out certain limitations found in the presently pending claims which should not be overlooked. All of the claims recite that the product is formed by freeform sintering and/or freeform melting. Freeform sintering and freeform melting are both manufacturing processes that include inducing a local high temperature to effect the sintering or melting. Such processes require consideration of local temperature and any negative consequences resulting therefrom. In particular, the question of thermal conductivity and thermal capacity of the product in the region of said sintering and melting spot is of relevance. The sintering and melting clearly delimits the claimed method from another important but substantially different rapid manufacturing process, namely stereolithography.

According to the method as claimed a compensation data set and/or compensation function is determined which compensates for manufacturing-related effects caused by the sintering and/or melting. As made explicit in claims 1 and 14, the compensation data set and/or function addresses deformations expected to occur after the product is released from the carrier. The deformations expected to occur after the product is released from the carrier are those deformations which are not apparent during the process of manufacturing the product in the rapid manufacturing apparatus. Naturally, during the time that the product is mechanically connected to the carrier, the rather rigid carrier will act against major or local deformations of the product. However, this counterforce is relieved as soon as the product is released from the carrier and thereafter the product will differ from the desired shape which was, however, present in the rapid manufacturing apparatus during its manufacturing. Thus, a specific major influence factor in deformations from desired shape is addressed by the compensation of the claimed methods.

The method of claims 1 and 14 defines that the deformations expected to occur after the product is released from the carrier result from stresses within the layers due to different thermal expansion of the layers. Thus, whereas in other manufacturing techniques negative effects like shrinkage or curl may adversely affect the process to follow the desired geometry defined by the data set, this different thermal expansion of the layers addresses a very specific problem occurring in high energy sintering and melting. Here, where the local sintering or melting and subsequent cooling of local spots does only to a minor degree result

in a general curling or shrinkage force applied by a newly formed layer, the influence of a temperature being conducted into the surrounding regions of the sintering or melting spot is of major relevance as discovered by the inventors. This basically lies in the fact that the sintering and melting and thus the establishment of a mechanical connection between the sintered and melted spot to the underlying layer takes place in a small, delimited region of the product which is at an elevated temperature when compared to the rest of the product. However, finally, the product will be at the same temperature over its whole geometry and thus such local thermal effects resulting in a local expansion or compression in adjacent regions may induce internal stresses which effect a deformation after the product has been released from the carrier.

When considering these important and claimed characteristics of the invention the examiner should come to the conclusion that neither US 5,238,639 ("Vinson") nor US 2002/0059049 ("Bradbury") render the invention obvious. These references shall now be addressed one at a time.

US 5,238,639 ("Vinson")

Vinson discloses a method for stereolithographic curl balancing. In stereolithography, a photocurable polymer is activated to change from liquid to solid in the presence of UV-light; this is explained in detail in Vinson, column 1, line 36. Actually, Vinson discloses specific problems and measures related to the problem of curl occurring in such stereolithographic process. It is important to notice that the whole Vinson document does not address any problems related to local thermal effects like the different thermal expansion of the layers as claimed. This results from the fact that in stereolithography no such temperature is induced as the curing of the material is effected by a chemical cross linking process induced by light but not a physical process like sintering or melting induced by temperature.

The claimed methods explicitly address a problem related to different thermal expansion which does not occur in a stereolithographic process at all. These differences must be considered when answering the question whether the skilled person will consider Vinson and whether the skilled person can learn from the Vinson disclosure relevant aspects related to the problems of freeform sintering and/or freeform melting solved by the invention.

Vinson describes a very specific stereolithography-related problem as motivation for the process modification described therein. This specific problem lies in a curling effect related to a common problem of material shrinkage in polymer materials. The curl effect is described to be an effect similar to that found when applying coatings to such things as a paper (Col. 2, l. 5-16). This problem of curl is in no way related to freeform sintering or freeform melting. The polymer materials subject to curl during stereolithography are not experiencing freeform sintering or melting. Thus, the general problem addressed in Vinson is not related to a problem which might occur in a freeform sintering or freeform melting apparatus.

From its general statement and teaching Vinson addresses a problem occurring between exactly two layers. In columns 3 through 5, Vinson discloses as a starting point for the technology three different techniques, namely the brick and mortar curl reduction technique, the multipass curl reduction technique and the riveting technique. All these techniques seek to reduce the mechanical contact of a newly formed layer to the underlying layer to reduce curl. All these techniques clearly seek to solve a problem related to a curl of a newly formed layer and its influence when being rigidly connected to the underlying layer. However, it is apparent that this starting point is of no relevance to freeform sintering or freeform melting. In freeform sintering and melting processes, where a newly formed layer is solidified and connected to the underlying layer by a sintering or melting process there is no option to reduce the mechanical contact of a newly formed layer. With freeform sintering or freeform melting, either mechanical contact is achieved or it isn't. There is no in between. Thus, options considered applicable to stereo-lithography where the extent of cross-linking can be selected to a lower or higher degree are not within the realm of applicability to the present invention.

When further analyzing the detailed teaching given in Vinson based on said starting point it becomes clear that Vinson addresses a method wherein deformations occurring in the manufacturing process are compensated by interaction of two explicit layers. To this extent, the whole product is divided up into a plurality of pairs of layers. Within such pair, the two different layers are defined as the "balanced layer and the balancing layer" (Col. 13, l. 64-Col. 14, l. 19). This specific approach is further explained in column 14, second paragraph by way of example of a two layer balancing process. In this paragraph a three layer or even multilayer balancing process is also explained. In summary, Vinson discloses a method for a

combination of multiple sets of balanced layers and balancing layers in which curling is reduced or completely avoided so that the product as manufactured in the stereolithography apparatus shall correspond to the geometry defined by the geometrical data set.

This, however, is to be denoted as an important difference to the claimed invention. According to claims 1 and 14, a compensation data set or function is provided which shall compensate for deformations resulting from stresses within the layers and occurring after the product is released from the carrier. This will usually require that the product as produced in the freeform sintering or freeform melting apparatus does not conform to the geometry of the data set. This is distinct from counterbalancing a curl using balancing and balance layers to thereby reduce and avoid any deformations from curl effects. Instead, according to the claims the product will usually have a geometry within the sintering or melting apparatus which is different from the geometry defined by the geometrical data describing the final product geometry. The final product geometry is not reached until the product is released from the carrier, thereby being deformed to its final geometry. Thus, a particular aspect of the invention is to be seen in the step to provide a compensation data set or compensation function which induces a geometry difference of the product as sintered or melted from that of the final geometry to compensate for other deformations resulting from the release of the product from carrier. This is neither an effect observed in stereolithography nor disclosed or rendered obvious by Vinson.

US 2002/0059049 Al ("Bradbury")

The Bradbury document focuses to a large extent in paragraph [0001] through paragraph [0112] only to aspects of how to handle data generated from medical imaging apparatuses in order to transform such data into data sets for generating three dimensional objects therefrom. Only in some later passages does Bradbury address specific aspects of the manufacturing process itself.

Bradbury only addresses a problem related to geometric deviation

from the desired product geometry in section [0065]. Herein, however, only a changing of the digital model, namely an enlarging of the entire part by a predetermined factor in all or certain directions to compensate for anticipated shrinkage during post manufacturing

processing steps is disclosed. This, however, in no way relates to the claimed particular method steps of providing compensation data or a compensation function which compensates for deformations resulting from stresses within the layers. Further, this disclosure in no way addresses a compensation of deformations expected to occur after the product is released from the carrier. Still further, this passage does not address information resulting from different thermal expansion of the layers.

For all the foregoing reasons, Applicants submit that the present application is in condition for allowance and early notice to that effect is respectfully solicited.

Date: May 11, 2011

Respectfully submitted,

/Robert M. Asher, #30,445/

Robert M. Asher
Reg. No. 30,445
Sunstein Kann Murphy & Timbers LLP
125 Summer Street, 11th Floor
Boston, MA 02110-1618
(617) 443-9292
Attorney for Applicants

3059A/00106 1452670.1